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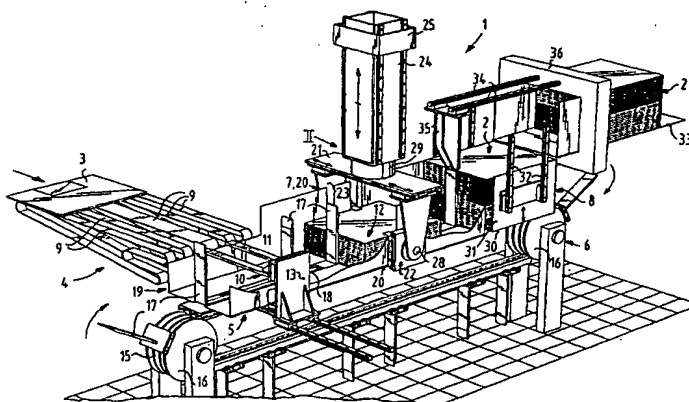
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(54) Title: METHOD AND APPARATUS FOR FORMING UNIFORM STACKS OF UNEQUAL, SUBSTANTIALLY FLAT OB-  
JECTS.



(57) Abstract: The invention relates to a method for forming uniform stacks (2) of unequal flat objects.(3) The method comprises the steps of feeding the objects, stacking the supplied objects onto each other in two equal part-stacks, transporting the part-stacks to a combining location and combining the part-stacks into a uniform stack at this location, wherein during the transport one of the part-stacks is separated off, rotated through a determined angle and once again transported further. The invention also relates to an apparatus (1)for performing the method, comprising means (4) for feeding the objects,(3) means (5) for stacking the supplied objects onto each other in two equal part-stacks, means (16) for transporting the part-stacks to a combining location, means (7, 20) for combining the part-stacks into a uniform stack (2) at this location, and means (7) arranged between the first stacking means and the combining location for separating one of the part-stacks from the transport means, rotating said part-stack through a determined angle and feeding said part-stack back again to the transport means.

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**METHOD AND APPARATUS FOR FORMING UNIFORM STACKS OF  
UNEQUAL, SUBSTANTIALLY FLAT OBJECTS**

The invention relates to a method for forming uniform stacks of unequal, substantially flat objects and to an apparatus for performing this method.

Different methods and apparatuses are already  
5 known for forming uniform stacks of flat objects which do not have the same thickness over their whole surface, such as for instance collapsed packing boxes. The forming of such uniform stacks is important when these packing boxes in the collapsed state have be packaged in  
10 an outer package or must be bundled in stacks, for instance for delivery to an end-user.

An apparatus is known from US-A-3 970 202 for forming uniform stacks of such objects. This known  
15 apparatus is provided with a feed conveyor which is rotatable on a horizontal axis between two positions. In each of these positions the conveyor comes out at a stacking location. The apparatus is further provided with a gripping mechanism with an arm pivotable on a  
horizontal axis. This mechanism picks up a stack from  
20 the one stacking location and moves it with a pivoting movement through 180° to the other stacking location, where the two stacks disposed in opposite directions are combined to form a single uniform stack.

In US-A-4 264 255 is described an apparatus  
25 with the same purpose having a feed conveyor leading to a first stacking station. This stacking station is provided with a removable base, whereby a stack can be lowered to a second stacking station situated thereunder. This second stacking station can be rotated  
30 through 180° about a vertical axis. After rotation of the stack on the second stacking station, a second stack can be lowered from the first stacking station and onto

the turned first stack, whereby a uniform stack is also formed.

In a similar apparatus as known from US-A-4 474 521 the feed conveyor comes out at a single stacking station. From this station the stacks are picked up by gripper means suspended from an endless conveyor. This conveyor carries the grippers with the stacks therein to a location where two stacks are combined into a single stack. The gripper means are herein alternately rotated through 180° and not rotated during the transport, so that successive stacks each face in opposing directions.

In US-A-5 078 260 is described an apparatus wherein from the feed conveyor there are provided two separate conveyors, each extending through a curved path. The paths of the conveyors are herein chosen such that the articles running along the one path are turned through 180° relative to the articles in the other path. Both transport paths lead to stackers placed mutually adjacently, both stacks of which are immediately combined to form a single uniform stack.

Finally, another apparatus is known from US-A-5 396 752 wherein stacks are formed on the infeed side which are then transported between two conveyor belts. A section of the two conveyor belts is herein received in a frame tiltable about an axis parallel to the transporting direction. By alternately rotating through 180° and not rotating the frame with the conveyor belts, successive stacks are placed in opposite directions to each other. After transport, these stacks in opposite directions are combined into a single uniform stack.

The invention now has for its object to improve the existing methods of forming uniform stacks on a basis of flat objects of unequal thickness. A stack is herein understood to mean not only a vertical stack

of horizontally oriented objects, but also a lying stack of upright adjacent objects.

According to a first aspect, the invention provides for this purpose a method for forming uniform  
5 stacks of unequal, substantially flat objects, comprising the steps of feeding the objects, stacking the supplied objects onto each other in at least two substantially equal part-stacks, transporting the part-stacks to a combining location and combining the part-  
10 stacks into a uniform stack at this location, wherein during the transport at least one of the part-stacks is separated off, rotated through a determined angle and once again transported further. Because the part-stack for rotating is separated off during transport, the  
15 rotational movement can be carried out in simple manner, while it is not necessary to keep much space clear for this purpose. In addition, the cycle time is thus hardly influenced by the rotational movement.

The at least one part-stack can be rotated on  
20 an axis substantially parallel to the main plane of the stacked objects, whereby the part-stack thus comes to lie with a different side facing outward. In addition or alternatively, it is also possible for the at least one part-stack to be rotated on an axis substantially  
25 perpendicular to the main plane of the stacked objects. The same side of the stack thus remains facing outward.

In order to orient the objects in opposite direction the at least one part-stack is preferably rotated through an angle of substantially 180°.

30 The part-stacks are advantageously enclosed substantially on all sides during the different steps. In this way is ensured that under all conditions properly oriented stacks are formed which can be further processed in simple manner, for instance can be placed  
35 in an outer package or bundled.

A method which is extremely simple to perform and which does not prolong the cycle time at all is obtained when transport of the part-stacks proceeds stepwise, and the separation and rotation of the at  
5 least one part-stack takes place between two steps.

According to a second aspect of the invention there is provided an apparatus for forming uniform stacks of unequal, substantially flat objects, comprising means for feeding the objects, means for  
10 stacking the supplied objects onto each other in at least two substantially equal part-stacks, means for transporting the part-stacks to a combining location, means for combining the part-stacks into a uniform stack at this location, and means arranged between the first  
15 stacking means and the combining location for separating at least one of the part-stacks from the transport means, rotating said part-stack through a determined angle and feeding said part-stack back again to the transport means. Such an apparatus is effective, has a  
20 large capacity and only requires a small floor space.

A particularly compact and efficient apparatus is obtained when the separating and rotating means are integrated with the combining means.

In order to enable rotation of the objects in  
25 controlled manner the separating and rotating means preferably comprise at least one gripping member for the at least one part-stack. To enable space to be created for the rotating movement the at least one gripping member is advantageously movable substantially  
30 transversely of the transporting direction.

The at least one gripping member can herein be rotatable on an axis substantially parallel to the main plane of the stacked objects and/or on an axis substantially perpendicular to the main plane of the

stacked objects. The objects can thus be subjected to different rotating movements.

For the purpose of receiving and collecting the supplied objects on a stack, the first stacking  
5 means preferably comprise at least one carrier member movable substantially transversely of the transporting direction. This at least one carrier member is advantageously movable in a first direction for forming of the part-stacks, and in a second direction for  
10 transferring of the formed part-stacks to the transport means.

For transfer of a series of objects from the feed means to the first stacking means, at least one movable separating member can advantageously be present,  
15 which co-acts with the feed means and which is to be placed in the path of the supplied objects.

The apparatus can further be advantageously provided with means for discharging the formed uniform stacks, which discharge means, just as the first  
20 stacking means, comprise at least one carrier member movable substantially transversely of the transporting direction.

In order to form optimally uniform stacks with straight edges, the first stacking means, the transport  
25 means, the separating and rotating means and/or the combining means are preferably adapted to enclose the part-stacks substantially on all sides. For this purpose the transport means can for instance comprise a conveyor guided between walls and having protruding displacing  
30 catches.

The invention will now be elucidated on the basis of an embodiment, wherein reference is made to the annexed drawing, in which:

Fig. 1 shows a partly cut-away perspective view of a stacking apparatus according to the invention, and

Fig. 2 shows a detail of the separating and  
5 rotating means as according to arrow II in fig. 1.

An apparatus 1 (fig. 1) according to the invention for forming uniform stacks 2 of substantially flat objects 3, the thickness of which is not equal over the whole surface thereof, comprises feed means 4, first  
10 stacking means 5 connecting thereto, transport means 6 placed in series with the first stacking means, separating and rotating means 7 arranged along the transport means and discharge means 8 connecting to separating and rotating means 7. The separating and  
15 rotating means 7 also function here as combining means 20, as will be elucidated hereinbelow. The objects 3 of unequal thickness are for instance collapsed packing boxes having a greater thickness for instance at positions where parts of the base or top part are folded  
20 into the packaging, or at the position of mutually overlapping side panels.

Feed means 4 are formed by a number of parallel endless belts 9 trained around reversing rollers (not shown here) and driven by a drive motor  
25 (likewise not shown here). On these belts 9 a number of objects 3 is supplied in partly overlapping manner. Placed above feed means 4 is for instance a counter (not shown here) which generates a signal when a determined quantity of objects 3 has passed. This signal activates  
30 a separating member (not shown here), for instance a number of fingers protruding upward between belts 9. These separating fingers are connected to their own drive, whereby they are moved in the direction of first stacking means 5 while carrying along the counted series

of objects 3. A predetermined number of objects 3 is thus transferred to stacking means 5.

Instead of a counter, a detecting member could also be used which detects an object 3 which has moved  
5 out of position, i.e. lies outside the overlapping row. This object 3 could have been pushed out of the overlapping row in the preceding machine, such as a folding/glueing machine, as a marker for a determined number of objects. Counting therefore takes place in  
10 this preceding machine.

Stacking means 5 are formed by a carrier member 10, here a fork, which is movable in the stacking direction by means of a drive (not shown here). In the shown embodiment the fork 10 is movable in height  
15 direction along a rear plate 13 to form an upright (part-)stack of horizontally oriented objects 3, although it is also conceivable that carrier member 10 could be moved away from feed belts 9 in horizontal direction to form a lying (part-)stack if the objects 3  
20 were to be supplied in vertical orientation, i.e.

standing on a side.

In the shown starting position the prongs 11 of fork 10 are situated at practically the same level as feed belts 9, or slightly thereunder. Each time a  
25 package 3 is pushed onto fork 10, this latter moves a step downward, whereby the upper side of upper package 3 on fork 10 then comes to lie flush with feed belts 9. This is continued until the final package of the series formed by the separating fingers has been pushed onto  
30 fork 10, whereafter this fork is moved further downward until the part-stack 12 formed thereon rests on transport means 6. Fork 10 with rear plate 13 is then pulled over a guide 14 out of the path of transport means 6 by means of a drive (not shown here).



Transport means 6 comprise a conveyor formed by two endless belts or chains 15, which are trained round two pairs of reversing rollers or chain wheels 16. The conveyor is driven by a motor (not shown) in  
5 stepwise manner at a speed determined by first stacking means 5 and/or the separating and rotating means 7 to be discussed hereinbelow. Fastened to each belt or chain 15 are relatively long displacing catches 17, the length of which is roughly equal to the height of the (part-)  
10 stacks 2 or 12 for transporting. By making use of two belts or chains 15 which are adjustable relative to each other, the mutual distance between displacing catches 17 can be adjusted to the size of the objects 3 for transporting. Displacing catches 17 can thus also be  
15 placed at the correct position relative to feed means 4.

Displacing catches 17 move through a central slot 18 in a U-shaped guide casing 19, which is formed by two L-shaped segments defining the bottom parts and side walls of guide casing 19. The mutual distance  
20 between displacing catches 17 and of the side walls of guide container 19 are chosen such that the (part-) stacks 12 are almost completely enclosed, and therefore held absolutely vertical. This mutual distance can be adjustable when it is desired to make the stacking  
25 apparatus 1 suitable for processing objects 3 of varying dimensions. The side walls of guide casing 19 extend over almost the whole transport path of the (part-) stacks and are only interrupted at the position of moving components, such as fork 10.

30 The conveyor carries part-stacks 12 to a station 20 with the separating and rotating means 7 and the combining means 20 integrated therewith, where each second part-stack 12 is picked up and turned. The separating, rotating and combining means 7, 20 comprise a  
35 bridge 21 from which two grippers 23 are suspended via

supports 23. The supports 23 with grippers 22 are movable in horizontal direction transversely of the transporting direction, so that grippers 22 can engage and release a part-stack 12 on the conveyor. Grippers 22  
5 comprise for this purpose claws 26 which are movable toward and away from each other and connected to a support plate 27.

The bridge 21 with grippers 22 is further movable transversely of the transporting direction, here  
10 in vertical direction. For this purpose the bridge 21 is suspended from a support 24 which can be shifted up and downward along guides 25 by a drive (not shown). In the moved-upward situation there is sufficient space to turn a part-stack 12 clamped in grippers 22. In the shown  
15 embodiment this turning can take place in two different ways.

Firstly, grippers 22 are mounted in supports 23 for rotation about a horizontal axis 28, whereby part-stack 12 can thus be turned upside down. This is a  
20 useful movement when it is for instance desired that on either side of the final stack 2 a rear side of the outermost object 3 is oriented outward, for instance in respect of possible damage.

In addition, bridge 21 is suspended from  
25 support 24 via a swivel bearing 29, whereby part-stack 12 can also be rotated parallel to the transporting direction. This rotating movement can be of importance when it is desirable that the objects 3 in the final stack 2 are all oriented outward with the same side.

30 Bridge 21 with grippers 22 can be held in moved-upward position after turning of part-stack 12 until the conveyor has carried a subsequent part-stack 12 to the separating and rotating means. Bridge 21 can then be moved downward, wherein the turned part-stack 12  
35 is placed on the newly supplied part-stack 12 to form a

uniform stack 2. The separating and rotating means 7 thus also function here as combining means 20.

The combined stack 2 can then be transported further to an end station 30 where there are situated  
5 discharge means 8 formed by two carrier members 31 movable transversely of the transporting direction. Each carrier member 31 is herein formed by an L-shaped segment which is connected onto guide casing 19 and which is movable up and downward along guides 32 by  
10 means of a drive (not shown). In the moved-upward position the underside of carrier member 31 and of stack 2 is herein situated at the level of a discharge conveyor 33. A pusher member 35 movable along guides 34 parallel to the transporting direction slides the stack  
15 2 from this position onto discharge conveyor 33. In the shown embodiment a tying device 36 is herein also present, whereby one or more tying members can be trained round stack 2.

It is otherwise also possible to have the  
20 discharge means 8 function as additional combining means. In that case the turned part-stack 12 is placed by bridge 21 with grippers 22 back onto transport means 6 between the same displacing catches 17 with which the stack was supplied, whereafter the transport means 6 are  
25 moved another step. Part-stack 12, which lies after this step under bridge 21 with grippers 22, is not picked up. Alternately turned and not turned part-stacks 12 are thus eventually supplied to end station 30. Here carrier members 31 are then first moved upward through the  
30 height of a part-stack 12, whereafter this part-stack is taken over by a retractable or collapsible support (not shown). Carrier members 30 are then moved downward again, the following part-stack 12 is fed thereon and this part-stack is then also picked up and moved upward.

The two part-stacks 12 are combined into a stack 2 by then retracting or collapsing the support.

Both separating and rotating means 7 and the discharge means 8 could otherwise function simultaneously as combining means, whereby multiples of two part-stacks 12 at a time could therefore then be combined into a single stack 2.

Stacking apparatus 1 according to the present invention thus enables the forming of uniform stacks 2 of unequal objects 3 in rapid and reliable manner. The capacity of apparatus 1 is herein high, while it also takes up a limited floor space. The (part-)stacks are moreover properly guided and held in place at each processing step, whereby a very regular end product is obtained.

Although the invention is elucidated above on the basis of one embodiment, it will be apparent that this can be modified and varied in many ways. The separating and rotating means 7 could for instance be adapted to execute a movement on only a single axis instead of the shown two axes. The rotation could even be omitted if a supply of completely flat objects 3 is presented.

The rotating movement could also be performed through an angle other than the shown angle of 180°. If the thicker part is situated only in a corner of object 3, it is conceivable for instance to combine four part-stacks 12 into a single stack 2, wherein each part-stack is then rotated through 90° relative to its adjacent part-stacks. It is also possible to rotate part-stack 12 through only 90° on the horizontal axis 28, whereby the originally vertically oriented part-stacks 12 could be combined to form a lying end stack 2.

In addition, the form of the different conveyors and the method of driving the different

movable components can of course be freely chosen, subject to the desired application.

The scope of the invention is therefore defined solely by the appended claims.

**Claims**

1. Method for forming uniform stacks of unequal, substantially flat objects, comprising the steps of feeding the objects, stacking the supplied objects onto each other in at least two substantially equal part-stacks, transporting the part-stacks to a combining location and combining the part-stacks into a uniform stack at this location, wherein during the transport at least one of the part-stacks is separated off, rotated through a determined angle and once again transported further.

2. Method as claimed in claim 1, **characterized in that** the at least one part-stack is rotated on an axis substantially parallel to the main plane of the stacked objects.

3. Method as claimed in claim 1 or 2, **characterized in that** the at least one part-stack is rotated on an axis substantially perpendicular to the main plane of the stacked objects.

4. Method as claimed in any of the foregoing claims, **characterized in that** the at least one part-stack is rotated through an angle of substantially 180°.

5. Method as claimed in any of the foregoing claims, **characterized in that** the part-stacks are enclosed substantially on all sides during the different steps.

6. Method as claimed in any of the foregoing claims, **characterized in that** transport of the part-stacks proceeds stepwise, and the separation and rotation of the at least one part-stack takes place between two steps.

7. Apparatus for forming uniform stacks of unequal, substantially flat objects, comprising means

for feeding the objects, means for stacking the supplied objects onto each other in at least two substantially equal part-stacks, means for transporting the part-stacks to a combining location, means for combining the  
5 part-stacks into a uniform stack at this location, and means arranged between the first stacking means and the combining location for separating at least one of the part-stacks from the transport means, rotating said part-stack through a determined angle and feeding said  
10 part-stack back again to the transport means.

8. Apparatus as claimed in claim 7,  
**characterized in that** the separating and rotating means are integrated with the combining means.

9. Apparatus as claimed in claim 7 or 8,  
15 **characterized in that** the separating and rotating means comprise at least one gripping member for the at least one part-stack.

10. Apparatus as claimed in claim 9,  
**characterized in that** the at least one gripping member  
20 is movable substantially transversely of the transporting direction.

11. Apparatus as claimed in claim 9 or 10,  
**characterized in that** the at least one gripping member is rotatable.

25 12. Apparatus as claimed in claim 11,  
**characterized in that** the at least one gripping member is rotatable on an axis substantially parallel to the main plane of the stacked objects.

13. Apparatus as claimed in claim 11 or 12,  
30 **characterized in that** the at least one gripping member is rotatable on an axis substantially perpendicular to the main plane of the stacked objects.

14. Apparatus as claimed in any of the claims 7-13, **characterized in that** the first stacking means  
35 comprise at least one carrier member movable

substantially transversely of the transporting direction.

15. Apparatus as claimed in claim 14,  
**characterized in that** the at least one carrier member is  
5 movable in a first direction for forming of the part-  
stacks, and is movable in a second direction for  
transferring of the formed part-stacks to the transport  
means.

16. Apparatus as claimed in any of the claims  
10 7-15, **characterized by** at least one movable separating  
member co-acting with the feed means and for placing in  
the path of the supplied objects.

17. Apparatus as claimed in any of the claims  
7-16, **characterized by** means for discharging the formed  
15 uniform stacks, which discharge means comprise at least  
one carrier member movable substantially transversely of  
the transporting direction.

18. Apparatus as claimed in any of the claims  
7-17, **characterized in that** the first stacking means,  
20 the transport means, the separating and rotating means  
and/or the combining means are adapted to enclose the  
part-stacks substantially on all sides.

19. Apparatus as claimed in claim 18,  
**characterized in that** the transport means comprise a  
25 conveyor guided between walls and having protruding  
displacing catches.



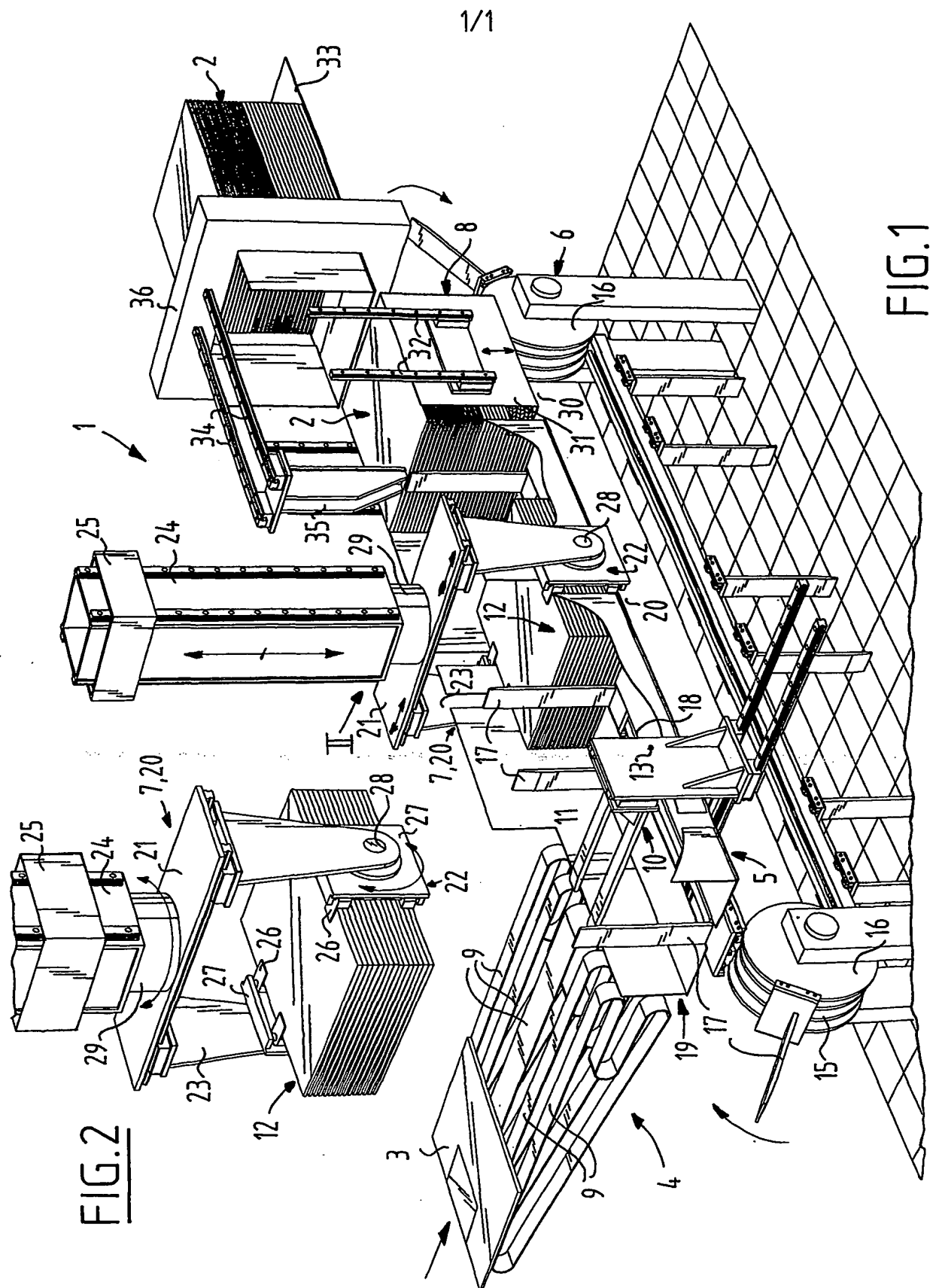


FIG. 1

## INTERNATIONAL SEARCH REPORT

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## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B65H15/02 B65H29/18 B65H31/04 B65H31/30 B65H33/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B65H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 619 571 A (PEIFFER JOSEPH) 28 October 1986 (1986-10-28) column 4, line 4 - line 18 figure 1	1,2,4-9, 11,12,16
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☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

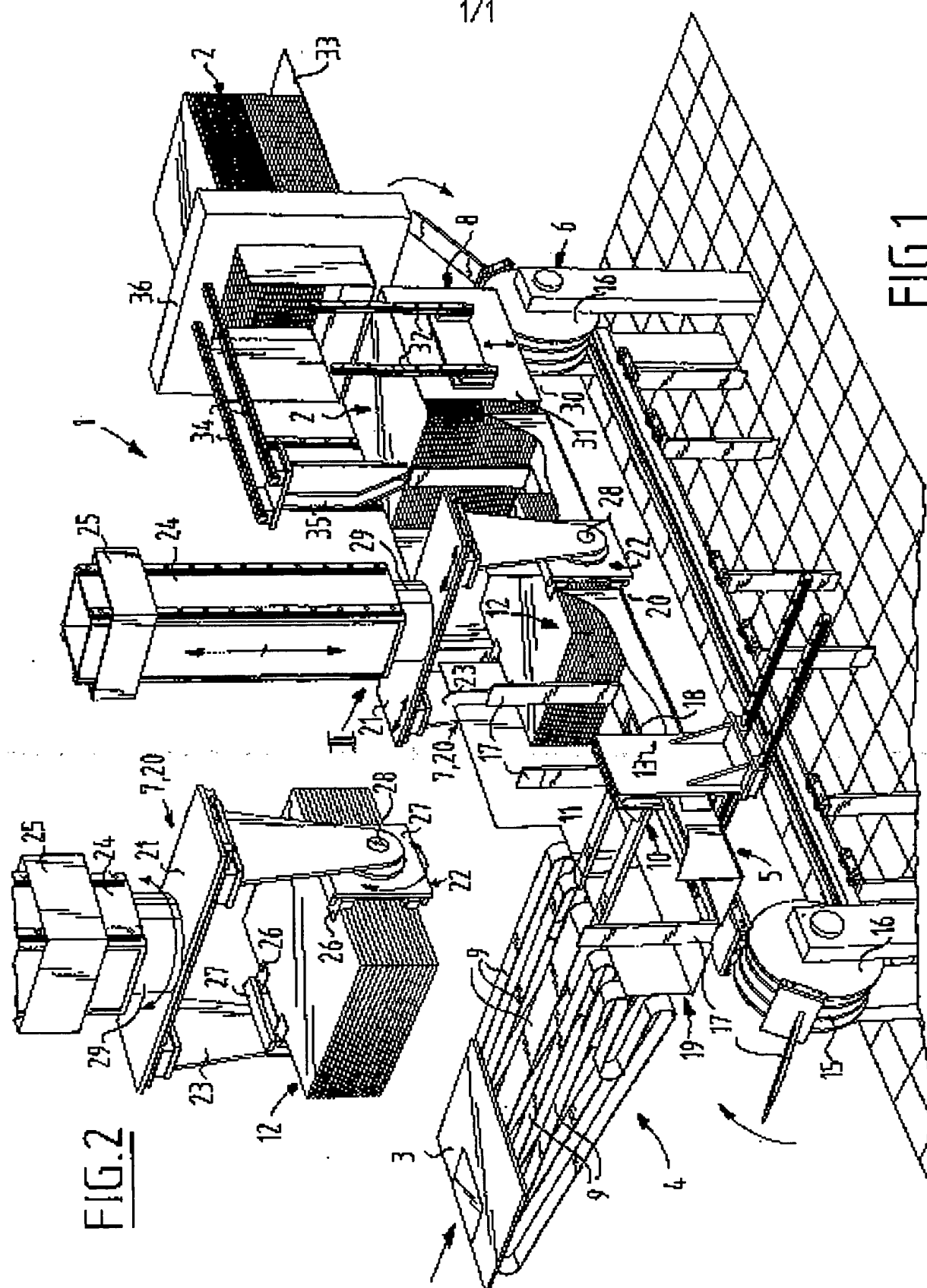
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**FIG. 2**

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1. The first part of the document is a list of the names of the persons who have been appointed to the various offices of the city of New York.